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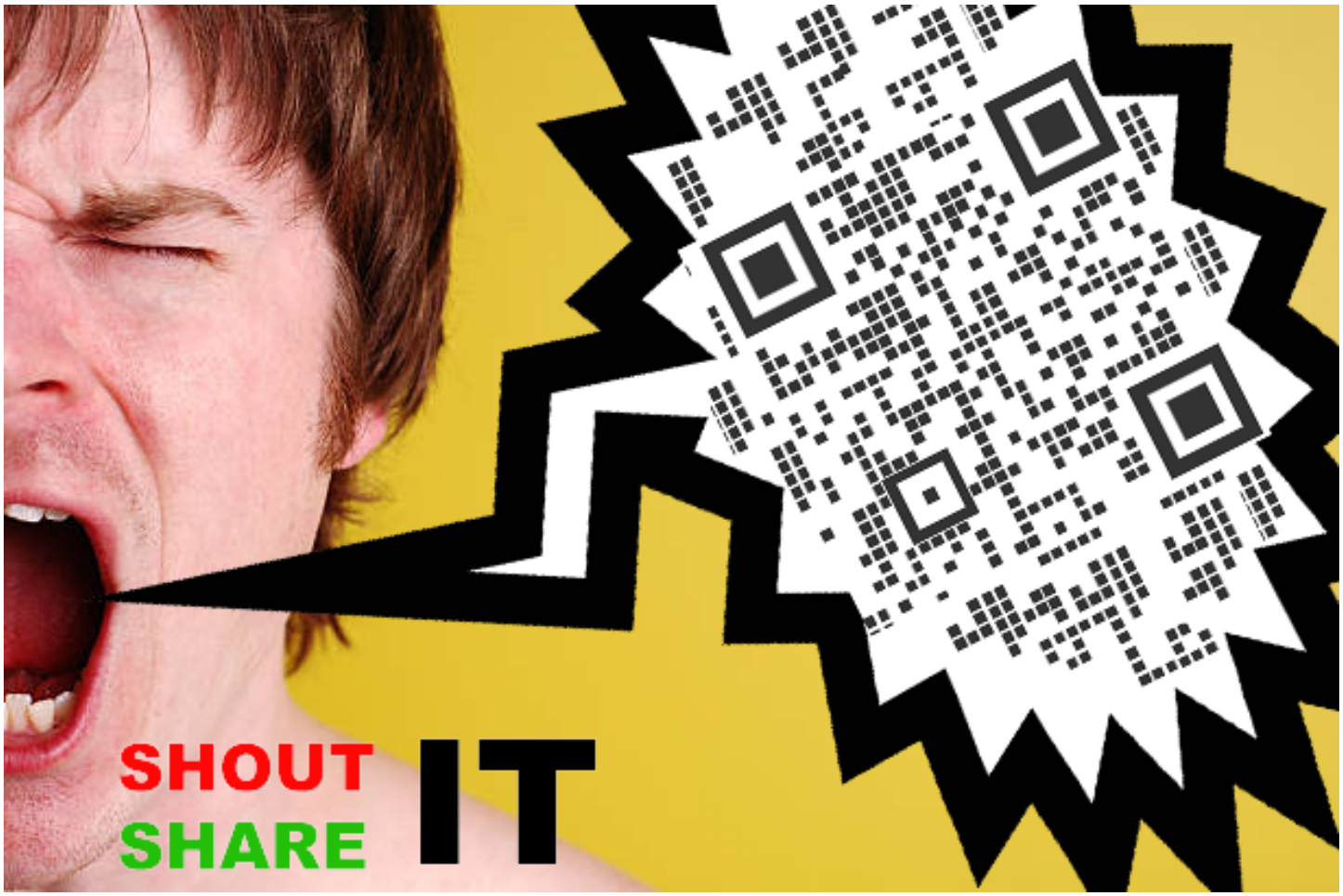
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LESSONS FOR AMERICAN POTATO GROWERS FROM GERMAN EXPERIENCES.

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INTRODUCTION.

In seeking the improvement of our agriculture we may advantageously take notice of the progress made by other countries and the methods that have resulted in their success, to the end that by a comparison and study of the relative conditions here we may gain a wider viewpoint and new ideas.

Those working for the betterment of our potato industry can find no country that will more richly reward study than Germany, where potato culture and the utilization of this crop have attained a high development.

RELATIVE IMPORTANCE OF THE POTATO IN GERMAN AND AMERICAN AGRICULTURE.

The potato in Germany takes a more important place than with us. Though the country is much smaller than the United States, the area planted is 8,165,000 acres, as compared with 3,566,000 acres in the United States.[1] The average total yield is 1,653,403,000 bushels, or 202.5 bushels per acre, as compared with our average of 343,587,000 bushels,[1] or 96.2 bushels per acre. If the States of Maine, New York, Michigan, Wisconsin, and Minnesota alone were to plant 12.5 per cent of their arable land in potatoes, as Germany does, and secure an equivalent yield, the product would amount to 1,558,944,000 bushels, 4½ times our present production from the entire country. At the present rate of consumption of potatoes in the United States, which is considerably less than 3 bushels per capita, the needs of the entire country could be supplied from any one of the States of New York, Michigan, Wisconsin, or Minnesota and leave a surplus unused, whereas all the States combined have several times failed to produce

[1] Five-year average, 1908 to 1912.

enough potatoes to supply the domestic consumption, and in such years large quantities of potatoes have been imported from foreign countries.

INDUSTRIAL USES FOR GERMAN POTATOES.

Such an immense production of potatoes as we find in Germany is manifestly not required to feed the people. As a matter of fact, only 28 per cent of the crop is used for human food, while 40 per cent is fed direct to farm animals and 12 per cent is set aside for seed purposes. The Germans plant over twice as many seed potatoes per acre as is the custom here, or more than 24 bushels. An additional portion of the surplus, in round numbers 100,000,000 bushels, a little less than 6 per cent of the total crop, is made into alcohol and used for industrial purposes and to replace petroleum products. Over 50,000,000 bushels, or about 4 per cent, are made each year into starch, dextrose, and related products. This accounts for all except 10 per cent of the German crop, which it is estimated is lost through decay.

It is difficult to secure American figures on which to base a comparison with the statistics quoted. It is probable that we plant on the average 11 bushels per acre for seed, or about 11 per cent of our total crop. Although exact data on disease injuries are very scarce, a recent survey indicates that as much as 15 per cent may be lost from decay, without taking into consideration the reduction of the crop from foliage diseases, which is even greater. Probably not more than 3,000,000 bushels are used annually for starch purposes, or less than 1 per cent, while the practice of feeding to stock is very limited, indeed, possibly 5 per cent being used in this way. No potatoes are made into alcohol and none are dried. It is evident, therefore, that approximately 68 per cent or more of our potatoes are used for table purposes.

TABLE I.—*Acreage, production, value, prices, exports, and imports of potatoes in the United States, 1900 to 1912, inclusive.*

Year.	Acreage planted and harvested.	Average yield per acre.	Production.	Average farm price per bushel Dec. 1.	Farm value Dec. 1.	Domestic exports for fiscal year beginning July 1.	Imports during fiscal year beginning July 1.
		Bushels.	*Bushels.*	*Cents.*		*Bushels.*	*Bushels.*
1900	2,611,000	80.8	210,927,000	43.1	$90,811,000	741,483	371,911
1901	2,864,000	65.5	187,598,000	76.7	143,979,000	528,484	7,656,162
1902	2,966,000	96.	284,633,000	47.1	134,111,000	843,075	358,505
1903	2,917,000	84.7	247,128,000	61.4	151,638,000	484,042	3,166,581
1904	3,016,000	110.4	332,830,000	45.3	150,673,000	1,163,270	181,199
1905	2,997,000	87.	260,741,000	61.7	160,821,000	1,000,326	1,984,160
1906	3,013,000	102.2	308,038,000	51.1	157,547,000	1,530,461	176,917
1907	3,128,000	95.4	298,262,000	61.8	184,184,000	1,203,894	403,952
1908	3,257,000	85.7	278,985,000	70.6	197,039,000	763,651	8,383,966
1909	3,525,000	106.8	376,537,000	54.9	206,545,000	999,476	353,208
1910	3,720,000	93.8	349,032,000	55.7	194,566,000	2,383,887	216,984
1911	3,619,000	80.9	292,737,000	79.9	233,778,000	1,237,276	13,734,695
1912	3,711,000	113.3	420,647,000	50.5	212,550,000	.....	.....

THE RÔLE OF POTATOES IN THE NATIONAL DIETARY.

The potato stands next to the cereals as the most important food of northern nations. In Germany this is particularly true, for the per capita consumption is 7.3 bushels, while ours is estimated at 2.6 bushels. An interesting study by Behrend[1] shows that the consumption of potatoes in Germany stands in inverse ratio to the wealth and social status of the people. The well-to-do people there use 3.6 bushels each per annum, the peasantry 8.8 bushels, and the laborers in western Germany 12.3 bushels, while in the eastern Provinces the per capita consumption of the poorer laborers is 17 bushels each per year.

The average wholesale price for table potatoes in Berlin, from 1908 to 1912, inclusive, was 30 cents per bushel; that in Chicago during the same 5-year period was 56 cents per bushel. A comparison with the prices of wheat and corn will show that the American people could often purchase a unit of food value more cheaply in the form of cereals than as potatoes, but the inherited taste for this vegetable is strong in us and will be satisfied, whatever the price. In the Southern States this is less true. Rice, corn, and sweet potatoes afford very satisfactory substitutes there.

INDIRECT BENEFITS OF POTATO GROWING.

The farm profits from the potato in Germany are not large, but they are reasonably sure, and, as in all business enterprises where the speculative element is eliminated, it is possible to run on a closer margin and to take account of small economies. Certain indirect benefits resulting from potato culture are influential in maintaining the acreage.

IMPROVEMENT IN SOIL PRODUCTIVITY.

One of the great problems in German agricultural economy is to increase the nation's harvests and at the same time to maintain the productivity of the soil. Particularly on the light, infertile soils of parts of eastern Germany was this an urgent necessity, and it is surprising to find what has been accomplished there by modern methods of crop rotation, green manuring, and fertilizing. It is the testimony of the German specialists that the potato has played the greatest rôle in this agricultural development, as the sugar beet has done in their heavier soils. These hoed root crops are beneficial to any soil, through the deep and thorough culture that is given them, with its resultant improvement in the physical condition and aeration. The profits from the crop justify the liberal use of commer-

[1] Behrend, W. Deutschlands Kartoffelerzeugung und Verbrauch in Gegenwart und Zukunft, Berlin, 1905.

cial fertilizers,[1] from which there are important residual effects on other crops in the rotation. The clean culture practiced also brings all weeds into thorough subjection. The yields per acre of all farm crops have been greatly increased since the extension of potato growing.

BY-PRODUCTS FOR FEEDING AND MANURE.

That 40 per cent of the entire crop is fed to live stock has already been pointed out. This is important for a diversified and profitable system of farming, since it not only gives a large return in meat from the 19,000,000 swine thus supported, but contributes an indispensable supply of stable manure to the upbuilding of the soil. The nearly 100,000,000 bushels that are made into alcohol are mostly worked up in farm distilleries, and the resulting by-product, or mash, possesses considerable value for feeding cattle, and thus returns the greater part of the fertilizing elements in the crop to the land. The more than 50,000,000 bushels that are converted into starch, dextrin, and related products enter quite largely into Germany's export trade. It should also be mentioned that potato tops are now dried and used for stock food on many estates.

A MAXIMUM ACREAGE THE POLICY.

For all these reasons the German farmers seek to plant a maximum acreage of potatoes, and when, through the abundance of their harvests, their various markets are oversupplied there is not so much talk of reducing production as of finding some new outlet for the surplus. This is illustrated by the development of the potato-drying industry. Previous to 1894 there had been an overproduction of potatoes and low prices, to relieve which the Government united with the organizations of the distillers and starch makers and with several agricultural societies to offer prizes, aggregating 30,000 marks, for the most practical and economical method of drying potatoes. After thorough tests of the apparatus designed by the competitors these prizes were awarded to several firms. That the method was successful has been demonstrated by the rapid increase in the number of factories for drying potatoes, which now number 371. In 1910 more than 12,200,000 bushels of potatoes were dried in these factories.

COMPARISON WITH AMERICAN CONDITIONS.

SOIL FERTILITY.

The disparity in the average yields of Germany and the United States is not due so much to the superior quality of the German soils

[1] The average expenditure for potato manures on 140 German estates was $10.68 per acre, less than is frequently used in Maine or in the trucking districts of other States. See Howard, W. H., Produktionskosten der wichtigsten Feldfrüchte, Aufl. 3, Berlin, 1908.

as to other reasons. We have, in fact, better soils than Europe in almost unlimited area, including types especially adapted for potatoes, and we actually produce, in a few sections where potato growing is made a specialty, as large crops as the Germans.

CLIMATE.

It must be recognized that northern Europe, with its cool and equable summer, has a climate better adapted to the potato than any except possibly the most northern part of the United States. The average mean temperature for July in Posen, in north Germany, is 64° F. Practically all of our potato districts, with the exception of Aroostook County, Me., lie south of the isotherm of 65° F., and the average summer heat in most of our potato States is not far from 10° higher than in Germany. Most of our varieties of potatoes are unable to withstand high temperatures and in the southern two-thirds of our country are subject to tip-burn, sun scald, and other troubles, which result in abnormal maturity. Farther south, as is well known, only early spring or fall crops can be grown. Much of the area of the United States is not in the potato belt.

On the other hand, the rainfall of Germany is often less than is needed for maximum production, and if we had a heat-resistant potato our more liberal precipitation would give us a decided advantage. The average annual rainfall in Posen is less than 19 inches, of which nearly 13 inches fall in the growing season, from April to October, inclusive. Northern Maine has, however, 20 inches during the same summer period, western New York about 24 inches, and Michigan 20 inches. In the irrigated districts of the Western States the potatoes receive perhaps even more water than they require. The cool nights of these regions and their midday heat subject the potatoes to temperature changes greater than are found in Germany.

COMPETITION WITH MAIZE AND PETROLEUM.

There is a fundamental economic condition in the United States that will always influence the extension of potato culture. The hot summers which are so injurious to the potato plant are ideal for the development of Indian corn, so that in the corn belt there can be no profit in growing potatoes in excess of those needed locally for table use. Corn can be produced more economically, is better for stock feeding, and is a cheaper source of starch, glucose, and alcohol. The scarcity and high cost of farm labor in the United States are other economic factors that influence the result. Farther north, however, and in the elevated districts of the West where corn can not so well be grown, the potato has a larger place.

The vast deposits of petroleum in the United States, which Germany lacks, also provide us with fuel oil and gasoline at prices which at present nearly eliminate alcohol as a competitor. Consequently, we do not have this stimulus to develop potato growing for distilling.

SOME REASONS FOR OUR LOWER YIELDS.

LACK OF ADAPTED VARIETIES.

As compared with the leading European countries, we have made unsatisfactory progress in the development of improved varieties of potatoes. On the other side of the Atlantic many skilled breeders have for years been engaged in this work. Findlay and Scarlett in Great Britain; Cimbal, Paulsen, Richter, and Böhm in Germany; and Dolkowski in Austria have each introduced a large number of promising sorts, and have made notable achievements toward greater productivity and better quality. It is to be hoped that many private breeders will engage in this fascinating work. Our needs for better varieties are much greater, for our climatic conditions are so diverse that potatoes adapted to special localities are required. Particularly do we need a heat-resistant strain that can more successfully withstand the high summer temperature of the Central and Southern States. Disease resistance is another quality that has been bred into many foreign sorts but is notably lacking in ours. Not only should we breed resistance to late-blight, but to wilt, scab, and other troubles prevalent here. It appears probable that leaf-roll and other new diseases, which many associate with varietal degeneration, are to be overcome only by selection and breeding.

We have already learned by experience that it is unprofitable to introduce European varieties, for they do not maintain their qualities here. We must breed American potatoes suitable for every need. We have much to accomplish in increasing the starch content of our potatoes, which is now lower than that of the German sorts by 4 to 8 per cent. Table quality is another requisite. The best European table varieties possess a superior flavor, color, and texture, particularly for boiling or frying. In this connection we may not overlook the need for several types—one for baking, another for frying, while a still more close-textured tuber is in some demand for salads. The percentage of waste in preparation for the table is so much greater in irregular, deep-eyed sorts that the shape of the tuber is a vital point.

NUMBER OF PLANTS TO THE ACRE.

A prominent reason for the low average yield per acre in this country is that we have, as a rule, fewer plants on an equal area. Not only are wider rows and more space between hills the common rule, but various other avoidable causes result in a poor stand. When

one travels through the country seeking the causes of low yields they are not hard to find. Imperfect preparation of the ground leaves a poor seed bed. The seed potatoes may be unselected, more or less diseased, cut too small, and carelessly planted. All these factors combine to produce a broken stand. Many of our fields outside of the leading potato districts have only half the number of plants that would be found in a Scotch or German field.

Carelessness is inexcusable, but the cheapness of our land and the dearness of our labor may justify wider spacing in many localities, if the use of implements is thereby favored.

FERTILIZATION AND CULTURE.

The use of commercial fertilizers is universal in Germany, but is unknown in the western potato districts and is only in an experimental stage in the Central States. We shall doubtless find it to our profit to use more fertilizers, following the example set by those districts in Maine, New York, and the Atlantic trucking belt where potato growing is now most prosperous.

Rotation of crops is of fundamental importance to all permanent agriculture, but especially for the potato crop, for the control of diseases and the maintenance of production. Germany has a long rotation, three to seven years between potato crops, the United States having only the beginning of an ordered system. The importance of green manuring is not yet fully appreciated here.

Thorough preparation of the land and frequent thorough cultivations are essential. Those farmers who have mastered these points of manuring, rotation, and culture are producing crops which approach European standards. The cost of production is, however, higher than it should be.

CONTROL OF DISEASES AND INSECTS.

American potato growers have more pests to contend with than European farmers. One, the late-blight, we have in common. In this field they have done more to produce resistant varieties, while we have excelled in spraying technique. The Colorado potato beetle and the potato flea beetle do not occur in Europe. Scab is not of importance there. Very much more has to be done here before we can feel that we are applying to the fullest extent our present knowledge relative to the control of insects and diseases. The advantages of spraying with Bordeaux mixture for the control of late-blight have been demonstrated annually for 10 years by the New York Agricultural Experiment Station at Geneva, yet last year millions of bushels of New York potatoes decayed because farmers failed to spray or did not spray thoroughly.

The problem of securing a supply of disease-free seed has been met and solved in Germany in a manner that could profitably be adopted in the United States, since we now have to deal with the same type of disease, the leaf-roll. This can not be detected by an examination of the seed, and an inspection of the growing crop becomes necessary.

In Germany this inspection is made upon request by expert representatives of the chamber of agriculture or of the German Agricultural Society, and certificates are issued to owners of disease-free crops.

Such a plan for the United States would be better if carried out by the cooperation of potato growers' associations, the State experiment stations, and the United States Department of Agriculture, rather than through legal enactment. It would be especially valuable to the growers in western districts where leaf-roll is prevalent and to southern truckers who require seed free from blackleg, scab, and dry-rot. The benefit would not be confined to the purchaser, who is in this way assured of the quality of his seed stock, for the producer would profit equally by the certification of his improved stock.

SHOULD WE INCREASE OUR PRODUCTION?

Under present conditions there are seasons of favorable weather, when the potato production of the country fully meets existing demands, and in some years the demand is, indeed, exceeded and the price falls below the cost of production. Too frequently, also, through drought or heat the crop is cut short and the price rises beyond what the consumer can afford to pay.

This situation is very bad from an economic standpoint. Both producer and consumer suffer in the long run. The farmer runs too great a risk, and the retail price of potatoes frequently exceeds their food value.

A commodity like the potato, which can not be preserved from one year to another, like grain, and which is too bulky to transport long distances, must be produced near the markets in ample quantities if stability of price is to be secured.

FOREIGN SUPPLY NO LONGER AVAILABLE.

In previous years of scarcity, potatoes have been imported from Europe in large quantities—7,000,000 bushels in 1901, 8,000,000 in 1908, and 13,000,000 in 1911. With them, however, came diseases hitherto unknown in America, like the blackleg and scurf and powdery scab; and the danger of importing the still more dreaded wart disease led the Secretary of Agriculture in September, 1912, to prohibit the importation of potatoes from Great Britain, Ger-

many, and Austria-Hungary, and from Newfoundland and near-by islands where the wart disease had already gained a foothold. The first-named countries have been the principal sources of foreign supply.

With our great resources, it should be entirely unnecessary for us to import potatoes, but unless the production is increased and maintained, years of shortage may recur and a serious condition arise.

AN OUTLET FOR SURPLUS PRODUCTION NEEDED.

The problem of supplying a nation with this important foodstuff at a reasonable price regardless of annual variations in yield has been solved by Germany.

There should be produced here, as in Germany, more potatoes than are required for table use and a profitable outlet developed for the surplus. The half of the German crop destined for stock food, alcohol, and starch constitutes an inexhaustible reserve, from which deficiencies in the supply of table potatoes may be filled. That this is effective is shown by the fact that the difference between the highest and lowest average monthly prices for potatoes in Berlin during five years was only 27 cents per bushel, while the fluctuation in Chicago during the same five years was $1.34. Until a surplus above the needs for table purposes is produced and means are provided for disposing of it at a profit to the grower the present succession of fat and lean years must be expected, and just so long potato growing for market will be a speculative enterprise.

We are not prepared to answer the question, In what way can surplus potatoes best be disposed of? This problem should receive the fullest investigation, and hand in hand with it should go measures for an increased potato production and for the lessening of the cost of production per bushel.

POSSIBLE USES FOR SURPLUS POTATOES.

INCREASED DOMESTIC CONSUMPTION.

Under the present system the retail prices for vegetables, especially when purchased in small quantities, are not very responsive to lower farm prices; consequently, consumption does not increase in seasons of plentiful harvests as much as would be the case if through better methods of distribution the price to the consumer were lowered. It is conceivable that changes along these lines would make it possible to market a great many more potatoes.

STOCK FEEDING.

It is quite likely that the utilization of potatoes in the United States may follow the same course of development as in Europe. We

have already noted that the principal uses made of the potato, aside from home consumption, are as stock food, for starch making, for the manufacture of alcohol, and for drying. That potatoes may be profitably used for feeding to swine is indicated by the fact that nearly 40 per cent of the entire German production is now so used.

Observation of the German feeding practices shows that the potato is, however, merely one component of a carefully planned ration. The potatoes are cooked and mixed with various farm by-products, such as skim milk, barley waste, linseed meal, peanut meal, etc. The quantity of potatoes recommended to be fed daily to each hog does not exceed 10 pounds. It is estimated that potatoes have a value of 25 cents per bushel for direct feeding. The difficulty in American potato districts is that the agriculture is not yet sufficiently diversified; the swine are not there to be fed. This will, however, be overcome as time passes and farm practices become better organized; then very large quantities of potatoes could be so utilized.

STARCH.

A certain quantity of potato starch is used in this country for sizing in cotton mills, for which purpose it is preferred to cornstarch. We have produced an average of 20,000,000 pounds of potato starch annually and have made large annual importations from Germany in addition. In 1910 there were imported 10,606,200 pounds of starch and 4,424,200 pounds of potato dextrin.

The manufacture of starch from potatoes in this country is at present confined to the utilization of culls and of potatoes unfit for storage or shipment because of partial infection with tuber rot. The margin of profit is not large, in spite of a protective tariff of one cent per pound. The factories are able to run only six weeks in the year, and the interest and other overhead charges are therefore high. It seems possible to make some economic improvements in this system by introducing new factory methods, and the quantity of potatoes used could be increased, especially in districts remote from the markets, where a more rigid sorting should be practiced before shipment and all inferior potatoes kept at home. This would not only tend to reduce freight charges, but would give the consumer in a distant market a grade of potatoes which would waste much less in preparation for the table and for which a relatively higher price could be paid than for the present unsorted shipments. There is a possibility also that a method may be worked out for drying culled and surplus potatoes on the farm and the dried product later used for starch making. The total quantity required would, nevertheless, not make a large impression on a surplus potato crop.

ALCOHOL.

That the manufacture of alcohol from potatoes has not yet become established in the United States is due to various reasons. The price of potatoes marketable for other purposes has been too high, and no sufficient supply of culls and surplus potatoes has been available. The average price for distilling potatoes in Germany for the five years 1906–1910 was 18.3 cents per bushel. It is probable that the farmers there would be less disposed to grow the crop if it were not for its indirect benefits, including the feeding value of the mash left after the distillation of the alcohol.

It is quite conceivable, however, that the rapid increase in the use of direct-combustion engines for automobiles and other purposes may within a few years so deplete the supply of gasoline that alcohol can be made here at a profit.

DRYING POTATOES.

The potato-drying industry in Germany, as has already been noted, is the last development in the utilization of surplus potatoes, and came about only through the absolute necessity of finding an outlet for the surplus production that could not be consumed by the starch and alcohol factories. The rapid increase in the number of potato-drying factories in Germany shows great promise for this young industry, and should merit the careful consideration of our people as to whether the time has not already arrived for the introduction of this method into the United States, at least on an experimental basis. The problems to be met relate mainly to the present cost of the labor in picking up and delivering to the factory the potatoes not marketable for table purposes. In many cases, however, it is necessary to remove these culls from the field to prevent the spread of potato diseases, and it would seem that the drier would pay for the labor involved. The dried product is adapted for many purposes. Not only cattle but horses have been fed the dried potatoes as a substitute for grain with perfect satisfaction.

SUMMARY.

The potato occupies a leading place in agriculture in Germany. The acreage is more than double that of the United States and the crop harvested more than four times our total.

Of these potatoes 40 per cent are fed to stock, 28 per cent are used for table purposes, 12 per cent for seed, 6 per cent for alcohol, 4 per cent for starch and related products, and 10 per cent decay.

The per capita consumption for food is 7.3 bushels per year in Germany, as compared with an estimate of 2.6 bushels in the United States.

A maximum acreage of potatoes is sought to secure the indirect benefits from the increased productivity of the soil, the control of weeds, and the use of by-products for feeding and manure.

Much of the United States is too hot in summer to compete with Germany in potato growing. Here corn fills the place very effectively. The most northern States may effect great improvements through better varieties, more liberal fertilizing, more thorough culture, and better control of insects and diseases.

We must hereafter produce enough potatoes to supply all our needs, as most sources of foreign imports have been closed by a plant-disease quarantine.

To do this economically we should find a profitable outlet for a surplus production, so that the producer may always receive a return for his crop and the consumer always purchase at a reasonable price.

The most promising use for culls and surplus potatoes appears to be in feeding hogs. There are possibilities in starch and alcohol and some hope of adapting the method of drying now used in Germany.

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